CML2

Analyser

User Guide

www.mpfiltri.co.uk

200.051-EN

Covers Model Numbers

CML2

SAFETY WARNING

Hydraulic systems contain dangerous fluids at high pressures and temperatures. Installation, servicing and adjustment is only to be performed by qualified personnel.
Do not tamper with this device.

Document Revision 4.1

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1 Precautions

1.1 Internal Cleaning

Do NOT clean the CML2 or Bottle Sampler with Acetone or similar solvents that are not compatible with the seal. For flushing fluids please see the website: www.mpfiltri.co.uk

The use of a 500µm coarse screen filter, screwed onto the HP connector, is recommended for heavily contaminated system. Please see the website above for part numbers.

1.2 Battery

(Series 41 only) It is recommended that the unit is charged for a minimum of 24 hours prior to first use, to fully charge the internal battery.

2 Introduction

The CML2 is designed to measure and quantify the numbers of solid contaminants in Hydraulic, Lubrication and Transmission applications. The CML2 is a portable, accurate, instrument suitable for laboratory or "on-site" applications utilising mineral oil as the operating fluid.

The instrument uses the light extinction principle whereby 2 laser light systems shine through the fluid and land on photodiodes. When a particle passes through the beam it reduces the amount of light received by the diode, and from this change in condition, the size of the particle can be deduced.

The CML2-W has the additional feature to allow the measurement of % saturation of water in oil (RH), and temperature (°C). The temperature measurement provides a reference temperature for the Relative Humidity reading (RH).

Due to the temperature gradient existing between the system tapping point and the RH/ temperature module, the temperature reading can be 5°C to 10°C less than the actual system temperature, depending on operating conditions.

Hydraulic and Lubricating Systems consists of sets of continuously moving metal parts, which use hydraulic fluid as the power medium. Hydraulic fluid is also used to create a lubrication film to keep the precision parts separated and it is also used as a cooling medium. The very nature of a hydraulic system is that it produces solid particulate contaminants and these are ever present in all hydraulic systems. There is a revised standard ISO cleanliness code ISO 4406: 1999 which classifies the numbers of particles that can be tolerated

within the system and it is these levels of contaminants that the particle counter is designed to measure.[1]

[1] *ISO Cleanliness Code* – The international standard for reporting solid contaminants is ISO4406: 1999, this standard has been revised to incorporate the change to ISO Medium Test Dust as the calibration standard.

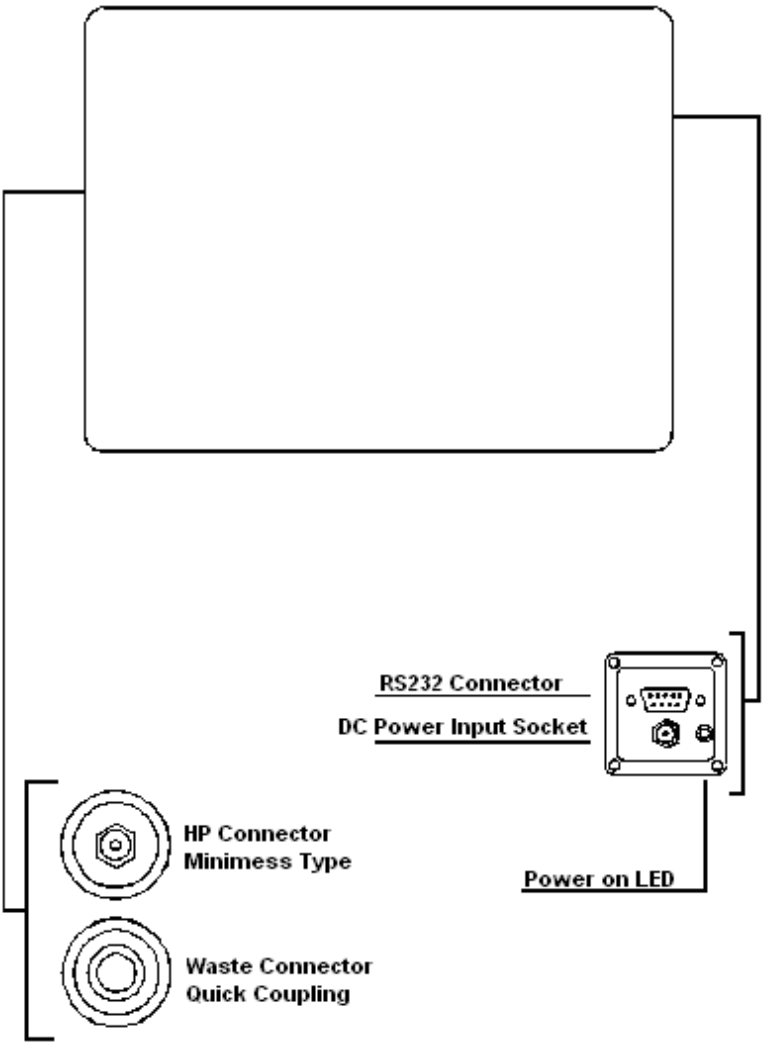


Figure 1 Series 35 Key Diagram

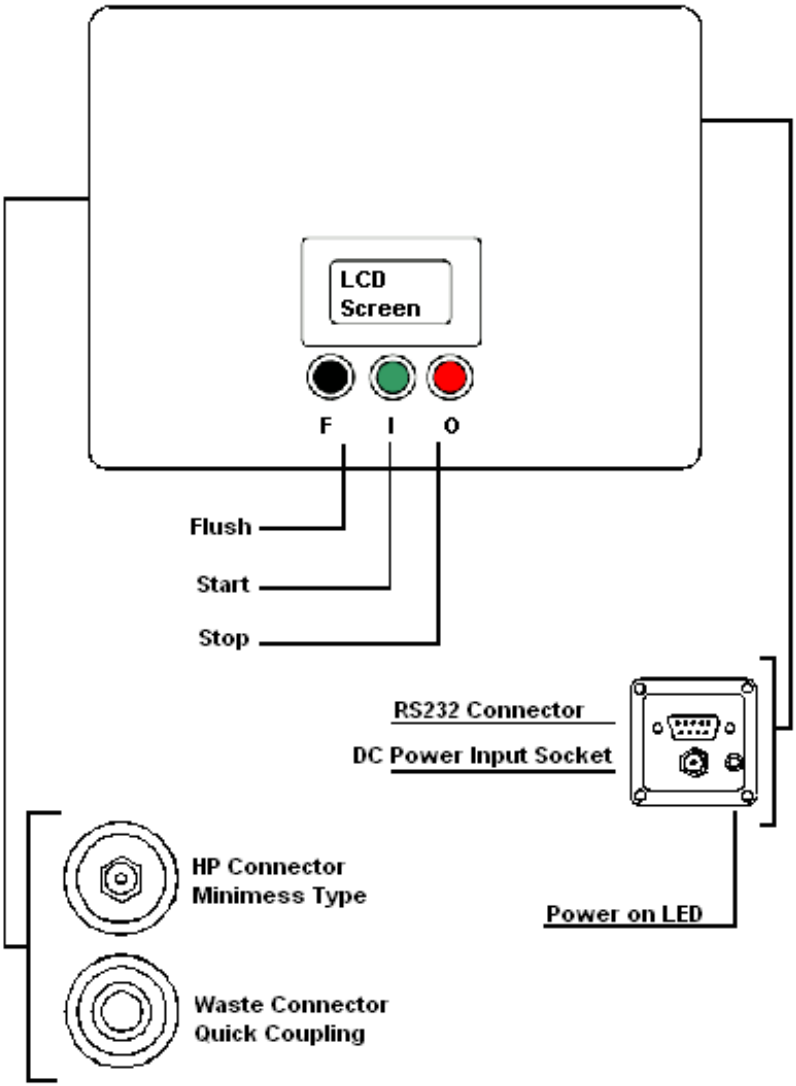


Figure 2 Series 40 Key Diagram

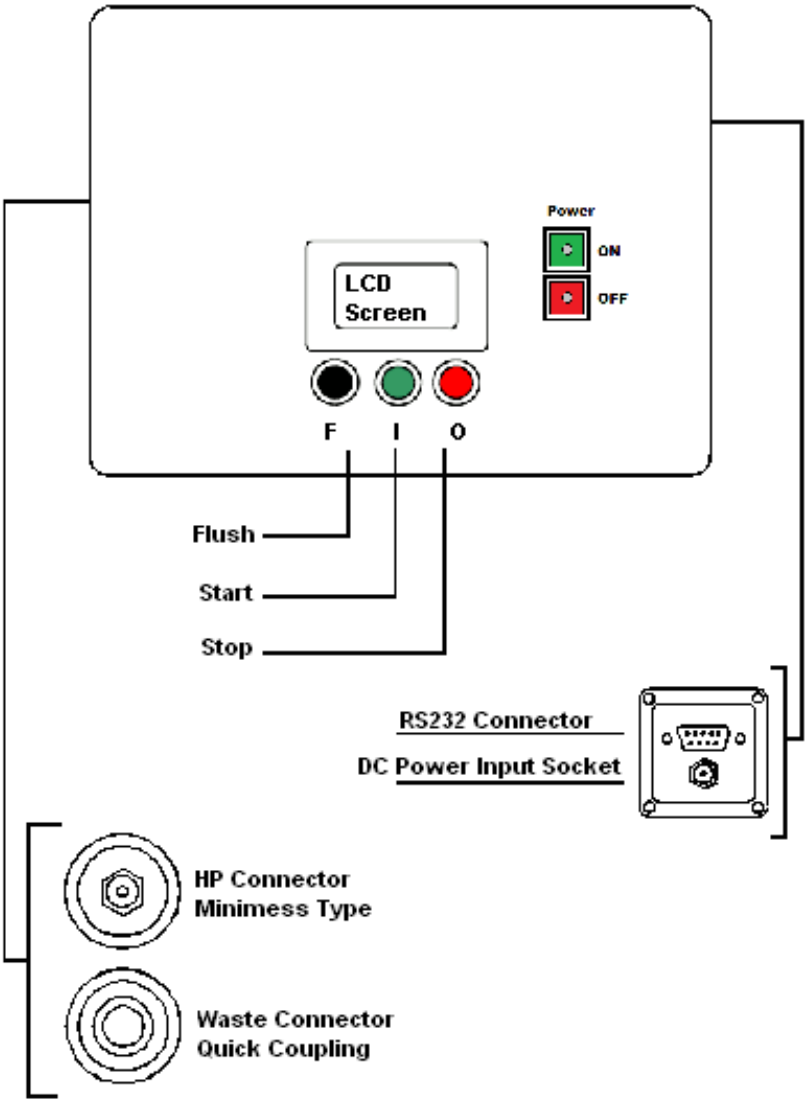


Figure 3 Series 41 Key Diagram

3 Scope of Supply

Each standard CML2 supplied consists of the following:-

- 1 x CML2
- 1 x CML2 particle counter accessories bag, containing:-
- 1 x Test hose x 1.5m long
- 1 x Waste hose x 2.0m long
- 1 x Waste bottle
- 1 x 15V DC power supply (series 35, 40)[2] or 12V (series 41)
- 1 x Calibration certificate
- 1 x CML2 User guide
- 1 x LPA-View CD Rom, software package
- 1 x LPA-View test analysis software manual
- 1 x USB to serial converter (used when computer has only USB ports)
- 1 x Serial cable

Optional Equipment:

- 500 µm coarse screen filter
- External Battery Pack

See page 66 for more details.

[2] This is a dedicated unit for the CML2 and should not be used with other MP Filtri UK products, especially the 12V Bottle Sampler Units.

4 Connection

Refer to key drawing on page 8.

1. Insert ***waste fluid hose*** in to the waste disposal bottle provided.

> Important! Do not connect waste fluid hose to a pressurised system, as this will cause the unit to malfunction and could cause internal leakage. The waste fluid hose must be discharged into the waste disposal bottle provided, or into a tank/vessel vented to atmosphere if running a continuous test due to the large quantity of oil discharged during a test.

2. Connect ***waste fluid hose*** to CML2 (waste connector). Push back quick coupling outer ring before connecting / disconnecting hose end.

3. Connect ***fluid sampling hose*** to CML2 (HP connector).

4. Connect ***fluid sampling hose*** to the system by means of the test connector.

> The system to be monitored must not exceed 400 bar or be less than 2 bar.

5. Connect the ***power supply*** to the connector. The "power on" LED will illuminate and the LCD screen will turn on. For series 41 the charging light will turn on and the On button should be pressed.

6. Installing ***LPA-View software*** – refer to the LPA-View User Manual and follow the CD Installation instructions.

7. Connect ***serial cable*** into the CML2 RS232 connector and the other end into a PC. If the PC has only USB ports, use the USB to serial converter and follow the instructions on page 22.

4.1 Methods of Operation

Users may operate the CML2 in two ways:-

1. Pushbutton Operation

2. PC Operation

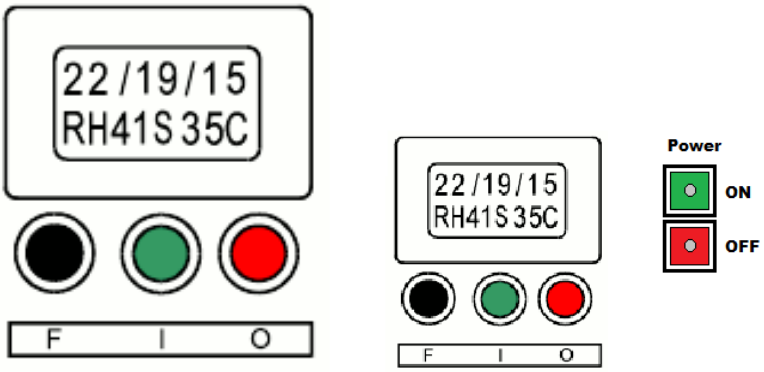
These are described in the following chapters.

> Please note that the series 35 units do not have the pushbutton operation and must be controlled by PC Operation.

5 Pushbutton Operation

This mode of operation is the most straightforward way to use the CML2, as the three principal operations of opening/closing the flush valve, starting a test and stopping a test can be readily performed using the pushbuttons.

Setting the types of test, downloading test results etc. are implemented using a PC running LPA-View software - refer to page 19 for details.



Series 40 Series 41

Figure 1

The LCD screen displays two lines of eight alpha-numeric characters. The top line is used to display the test code; the bottom line – showing RH % (Relative Humidity) and Temperature °C – only appears on the CML2-W version.

When first switched on the display unit will show the letters MP Filtri UK - Remote Display Unit on the first screen shot, followed

by a software version number on the second screen shot, e.g. RDU V0.6.

1 Power ON/OFF buttons (Series 41 only)

GREEN - Switches the CML2 unit on: Note; the in-built LED is used to display a 'low battery' warning - this will illuminate 'red' if the battery has insufficient power.

RED - Switches CML2 unit off: Note; the in-built LED is used to display a 'unit charging' warning - this will illuminate 'red' if the mains supply is connected.

2 Status Letters

During a test a status letter flashes in the centre of the bottom line.

The letters denote the following:-

- **-** System ready or user stop
- ***S*** Sampling
- ***E*** Emptying
- ***F*** Flushing
- ***W*** Waiting (Continuous testing only)
- ***C*** Test Completed (Continuous testing only)

3 Pushbuttons

- F – Black – Toggles the flush valve open and closed.
- I – Green – Starts a test.
- O – Red – Aborts a test.

4 Cleanliness Codes

ISO4406 Code – The test result is displayed as a three part code e.g. 22/19/16.

NAS1638/AS4059E-1 Class – A single number is displayed, which is the highest recorded in all of the sizes, e.g. NAS 8.

AS4059E-2 – A single number is displayed, which is the highest recorded for all of the sizes, e.g. AS 7.

5.1 Using the Pushbuttons

All new CML2's are factory set to perform a normal test, which consists of one test sampling 15ml of fluid. Other test types can be selected using a PC running LPA-View - refer to page 19.

When running a Normal test the user will first make the oil and power supply connections as described on page 12.

Follow the actions below to perform a Normal test:

- ***Press Flush Pushbutton (F)***

This will open the flush valve to allow fluid to pass through the CML2, so that any fluid from the previous test is flushed out of the

connecting pipe to eliminate the possibility of cross-contamination between tests. The time for which the flush valve is left open depends on the distance of the CML2 from the system being sampled. As a guide, a 200ml flush volume is recommended when using the 1.5m long test hose.

After the 200ml flush volume has been discharged to waste the flush valve may be manually closed by again pressing pushbutton F. Alternatively, the flush valve will close automatically when pushbutton Start (I) is pressed.

Note! For version CML2-W (moisture and temperature indication), every test is automatically preceded by a 3 minute flush period, to allow the moisture sensor to stabilise and give an accurate reading. The 3 minute period starts from the time the Start pushbutton (I) is pressed. Therefore, a separate flush period is unnecessary, unless a flush period greater than 3 minutes is required. For the CML2-W version the moisture and temperature function can be switched off - refer to page 29 for details.

- ***Press Start Pushbutton***

  This will initiate the commencement of a test. Each test comprises a sampling cycle that sizes and counts the particles in a 15ml volume of test fluid, followed by an emptying cycle during which the 15ml of fluid is discharged to waste. At the end of the emptying cycle the CML2 will come to rest and the test results will be displayed on the LCD screen.

- ***Stop Pushbutton (O)***

  This optionally *aborts* the test at any point in the sampling/ emptying cycle. Please note: The next test will start with an emptying cycle before the test commences.

5.2 Downloading the Results

After using Pushbutton Operation the test results can be downloaded.

The CML2 has a memory capacity of approximately 600 tests. When this memory is full, the earliest of the test records will be over-written by the new tests.

Connect the CML2 to a PC running LPA-View and follow the instructions given to Transfer Log on page 24.

It is important to set the Test Reference (refer to page 25) before transferring the test results, as all results transferred to the databasewill be given the same Test Reference that is active at the time in the Settings dialogue box.

If the User is carrying out tests at different locations and wishes to give the tests different references it is necessary to download the tests after each location, followed by changing the Test Reference for the next location. Alternatively, the Test Reference may be edited at a later date by accessing the individual test record using LPA-View - refer to the separate LPA-View test analysis software manual.

6 PC Operation

PC control of the CML2 is performed using the Remote Device Dialogue included in the LPA-View software package - refer to the separate LPA-View user manual for details of software installation.

Users may typically wish to operate the Remote Device Dialogue facility in one of two ways:-

- ***Direct Online Operation***

  The particle counter is permanently connected to a computer whilst tests are carried out. The operator can set the test parameters, initiate the test, monitor the progress of each test, and download each test as it is completed.

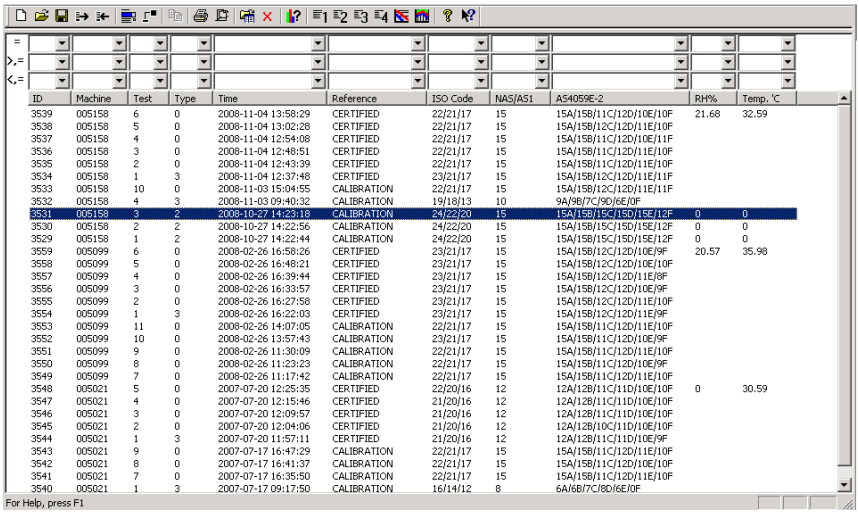
- ***Disconnected Operation using Continuous Test Type***

  The CML2 operates as a stand alone item, performing tests as defined for the Continuous Test. Occasionally the operator connects a PC and uses LPA-View to download the accumulated test data.

6.1 Using the Computer Serial Port

This connection is made using the standard computer connecting cable supplied with the CML2.(If the computer has only USB to serial ports, use the USB to serial converter and follow the instructions on page 22).

Apply power to the CML2, make the PC connection and then start LPA-View running.



ID	Machine	Test	Type	Time	Reference	ISO Code	NAS/AS1	AS4059E-2	RH%	Temp. °C
3539	005158	6	0	2008-11-04 13:58:29	CERTIFIED	22/21/17	15	15A/15B/11C/12D/10E/10F	21.68	32.59
3538	005158	5	0	2008-11-04 13:02:28	CERTIFIED	22/21/17	15	15A/15B/12C/12D/11E/10F		
3537	005158	4	0	2008-11-04 12:54:08	CERTIFIED	22/21/17	15	15A/15B/11C/12D/10E/11F		
3536	005158	3	0	2008-11-04 12:48:51	CERTIFIED	22/21/17	15	15A/15B/11C/12D/11E/10F		
3535	005158	2	0	2008-11-04 12:43:39	CERTIFIED	22/21/17	15	15A/15B/11C/12D/11E/10F		
3534	005158	1	3	2008-11-04 12:37:48	CERTIFIED	23/21/17	15	15A/15B/12C/12D/11E/11F		
3533	005158	10	0	2008-11-03 15:04:55	CALIBRATION	22/21/17	15	15A/15B/12C/12D/11E/11F		
3532	005158	4	3	2008-11-03 09:40:32	CALIBRATION	19/18/13	10	9A/9B/7C/9D/6E/0F		
3531	005158	3	2	2008-10-27 14:23:18	CALIBRATION	24/22/20	15	15A/15B/15C/15D/15E/12F	0	0
3530	005158	2	2	2008-10-27 14:22:56	CALIBRATION	24/22/20	15	15A/15B/15C/15D/15E/12F	0	0
3529	005158	1	2	2008-10-27 14:22:44	CALIBRATION	24/22/20	15	15A/15B/15C/15D/15E/12F	0	0
3559	005099	6	0	2008-02-26 16:58:26	CERTIFIED	23/21/17	15	15A/15B/12C/12D/10E/9F	20.57	35.98
3558	005099	5	0	2008-02-26 16:48:21	CERTIFIED	23/21/17	15	15A/15B/12C/12D/10E/10F		
3557	005099	4	0	2008-02-26 16:39:44	CERTIFIED	23/21/17	15	15A/15B/12C/12D/11E/8F		
3556	005099	3	0	2008-02-26 16:33:57	CERTIFIED	23/21/17	15	15A/15B/12C/12D/10E/9F		
3555	005099	2	0	2008-02-26 16:27:58	CERTIFIED	23/21/17	15	15A/15B/12C/12D/11E/10F		
3554	005099	1	3	2008-02-26 16:22:03	CERTIFIED	23/21/17	15	15A/15B/12C/12D/11E/9F		
3553	005099	11	0	2008-02-26 14:07:05	CALIBRATION	22/21/17	15	15A/15B/11C/12D/11E/10F		
3552	005099	10	0	2008-02-26 13:57:43	CALIBRATION	23/21/17	15	15A/15B/11C/12D/10E/9F		
3551	005099	9	0	2008-02-26 11:30:09	CALIBRATION	22/21/17	15	15A/15B/11C/12D/11E/10F		
3550	005099	8	0	2008-02-26 11:23:23	CALIBRATION	22/21/17	15	15A/15B/11C/12D/10E/9F		
3549	005099	7	0	2008-02-26 11:17:42	CALIBRATION	22/21/17	15	15A/15B/11C/12D/11E/10F		
3548	005021	5	0	2007-07-20 12:25:35	CERTIFIED	22/20/16	12	12A/12B/11C/11D/10E/10F	0	30.59
3547	005021	4	0	2007-07-20 12:15:46	CERTIFIED	21/20/16	12	12A/12B/11C/11D/10E/10F		
3546	005021	3	0	2007-07-20 12:09:57	CERTIFIED	21/20/16	12	12A/12B/11C/11D/10E/10F		
3545	005021	2	0	2007-07-20 12:04:06	CERTIFIED	21/20/16	12	12A/12B/10C/11D/10E/10F		
3544	005021	1	3	2007-07-20 11:57:11	CERTIFIED	21/20/16	12	12A/12B/11C/11D/10E/9F		
3543	005021	9	0	2007-07-17 16:47:29	CALIBRATION	22/21/17	15	15A/15B/11C/12D/11E/10F		
3542	005021	8	0	2007-07-17 16:41:37	CALIBRATION	22/21/17	15	15A/15B/11C/12D/10E/10F		
3541	005021	7	0	2007-07-17 16:35:50	CALIBRATION	22/21/17	15	15A/15B/11C/12D/11E/10F		
3540	005021	1	3	2007-07-17 09:17:50	CALIBRATION	16/14/12	8	6A/6B/7C/8D/6E/0F		

For Help, press F1

Figure 1 LPA-View

To access the Remote Device facility in LPA-View, press the Remote Control button on the toolbar.

The first time that this is done, the correct communications port (COM port) on the computer has to be selected, as detailed below.

1. The program scans the computer for available ports, and puts them in a list to choose from - this list appears in the box. Click on the right hand side of this box and choose the connection on your computer. Refer to Section below: Determining COM Port.

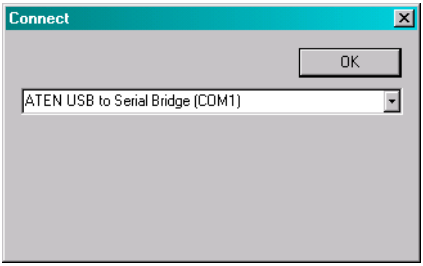


Figure 2 COM Port selection

2. Press the OK button, when the correct port is chosen, the Remote Device dialogue will show the remote device values.

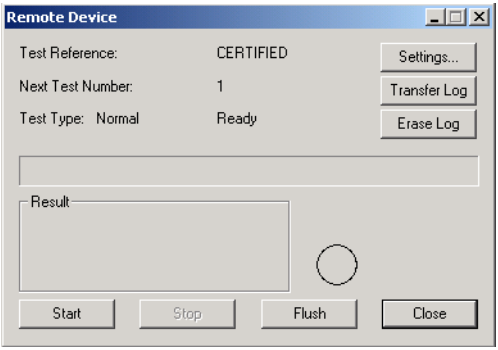


Figure 3 Remote Device dialogue

The LPA-View program will remember this selection the next time it is used.

6.2 Determining the COM Port

To check the COM port number allocated by the computer for the Serial lead or the USB to Serial Connector:

- *Windows 2000, Windows XP, Windows Vista*
  - Right click on My Computer icon and then left click on Properties.
  - Click on the Hardware tab and then click on the Device Manager Button.
  - Click on the plus sign next to Ports (COM & LPT).
- *Windows 7*

- View the installed devices using Start Button/Devices and Printers.

- You should see an icon representing the port.

  - "Communications port"- if using the Serial lead.
  - "ATEN USB to Serial Bridge" or "Prolific USB-to-Serial Comm Port" if using an adaptor cable.

- Either of these will have a COM number after it. This is the number you should use when selecting the Com Port.

6.3 USB Port

When a built-in computer serial port is not available the USB to serial converter can be used.

- Connect CML2 to the computer using the Serial Cable and the USB to Serial Converter.

- Install the Prolific driver from the file: PL2303_Prolific_DriverInstaller_v110.exe on the provided CD.

- You will need to accept any warnings about making changes to your computer.

- Follow the installer Wizard, accepting the defaults.

- When the Installer has completed, plug in the USB to Serial Adaptor.

- A message should pop up indicating successful hardware installation. Note any COM port number indicated in the message.

- Connect the CML2 to the computer using the Serial Cable and the USB to Serial Converter.
- If necessary, determine the COM port allocated by the computer for this device using the procedure above.

6.4 Operating the CML2

The following describes the function of the buttons on the Remote Device dialogue.

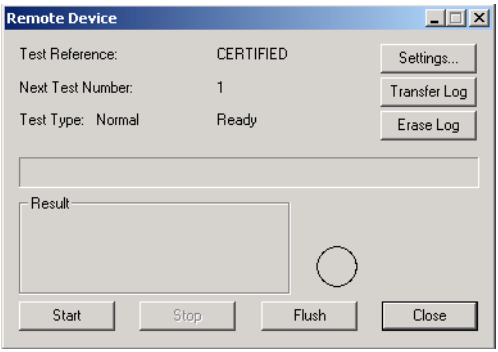


Figure 4 Remote Device dialogue

Start Starts sampling and emptying cycle.

Stop Stops test at any point in the sampling / emptying cycle. Next test will start with an emptying cycle before the test commences.

Flush The flush valve must be opened to allow fluid to pass through the CML2, so that any fluid from the previous test is flushed out of the connecting pipe to eliminate the possibility of cross-contamination between tests. The time for which

the flush valve is left open depends on the distance of the CML2 from the system being sampled. As a guide, a 200ml flush volume is recommended when using the 1.5m long test hose.

Press the Flush button to open the flush valve, and press the Stop button to close it.

The Flush indicator turns yellow in colour when flushing is in progress.

Connect Refer to Remote Control section page 19.

Close This closes the Remote Device dialogue box.

6.5 Log

The CML2 can be operated permanently connected to a computer with the Remote Device dialogue open. This allows the user to set up a continuously updated trend graph and list view. As each test is completed, the trend graph and list view are updated.

However, it is not necessary to keep the Remote Device dialogue open and computer connected after the test has been initiated, although most users will find this more convenient. This fact is especially useful for the continuous test mode, when a test sequence might be programmed to take several hours. In this case, pressing the Transfer Log button (describe below) will transfer the complete result log of the CML2 into the test database.

Transfer Log As explained immediately above, if the CML2 has been operated as a stand alone item, then connecting the computer to the CML2 and pressing the Transfer Log button will transfer all the

test results into the test database that have occurred since the last time the transfer was carried out.

The CML2 has a memory capacity of approximately 600 tests. When this memory is full, the earliest of the test records will be over written by the new tests.

Erase Log This erases all the test results that are stored in the CML2 memory.

Settings Opens the Settings dialogue, described in the next section.

6.6 Settings

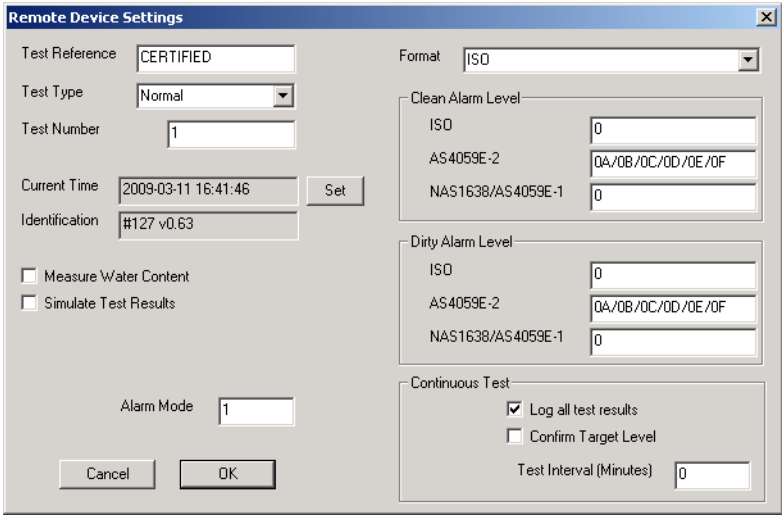


Figure 5 Remote Device Settings dialogue

Use this dialogue box to examine the current settings stored in the CML2, and change the settings.

After making any changes, pressing the OK button will update the CML2 with the new settings. Or press Cancel to leave the settings as they were.

Test Reference Type in this box the description you wish to use for the test, e.g. Vehicle 012. Up to 14 characters may be used.

Test Type Used to select one of the five available test types. It is recommended that the CML2 be usually operated in either the Normal test mode or the Continuous test mode, until the user is fully familiar with the features. The CML2 test menu is harmonised with that of MP Filtri UK's other CMP and so can also perform Short, Triple/Bottle and Dynamic tests.

Normal Single Test: 15ml sample volume.

Dynamic A comprehensive triple test[3] with results averaged: 30ml sample volume comprised of three 10ml sampling and emptying cycles. Allows the effect of system fluctuations to be measured over a longer period of time.

Triple / Bottle Sampling A triple test with results average and quicker than the Dynamic Test: 24ml sample volume comprised of three individual 8ml samples tested consecutively. For Bottle Sampling refer to separate User Guide.

[3] Results will be displayed upon completion of three tests – including emptying cycle

Continuous For detailed instructions refer to Continuous Sampling, page 30.

Short Single Test: 8ml sample volume. This provides results in less time than the Normal Test. It is not recommended for oil samples cleaner than ISO 17/15/12 (NAS 6), as the accuracy of the result might be compromised by the 'small' sample volume

Test Number Input desired number, e.g."123". (Test number will automatically increment for each successive test).

Simulate Test Results This is useful for checking device communications and familiarisation with the software, especially when an oil supply is not available. When a simulated test is performed, the particle counter will generate test results without being connected to a hydraulic system.

Format Choose the preferred display format (ISO4406:1999, NAS1638 / AS4059E-1, AS4059E-2). This also sets which of the cleanliness targets is used for the continuous test mode.

Serial Number The serial number of the CML2. This is recorded in each test result. (The serial number, together with the test timestamp, uniquely identify the test record. These two parameters are used to avoid duplication of test records.)

Software Revision This identifies the program running on the CML2.

7 Normal Test

7.1 CML2 without Moisture Sensor

1. Input settings as described on page 25 for the following:-
   - Test Reference
   - Test Type - select Normal
   - Test Number
   - Format
2. Press OK button to return to Remote Device dialogue.
3. Press Flush button to open flush valve - flush indicator turns yellow colour to indicate valve is open. Leave valve open until at least 200ml has passed to waste.
4. Press Stop button to close flush valve.
5. Press Start button. The CML2 will now commence the sampling cycle.
6. The completion bar indicates progress of the test and the status is shown as Sampling.

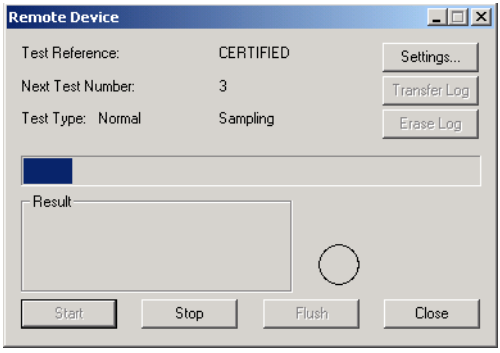


Figure 1 A Test in Progress

7. At the end of the sampling cycle the test result will be displayed in the Remote Device dialogue box.

   If the Remote Device dialogue is open, the test results will be automatically transferred to the test database.

   Following the sampling results the CML2 discharges the sample fluid to waste. Test status is shown an Emptying.

   When emptying cycle is finished the status is shown as Ready, and another test can then be started.

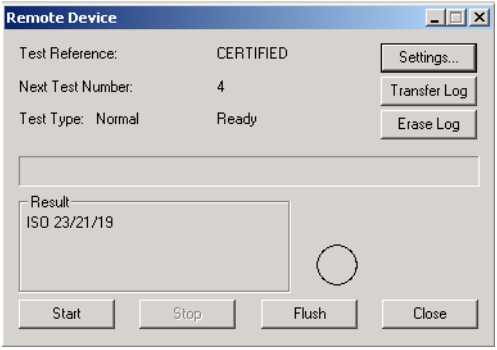


Figure 2 A Completed Test

7.2 CML2-W with Moisture Sensor

The procedure is similar to that detailed for the CML2 without moisture sensor (previous section), except when the Start button is pressed the flush valve will open automatically for a period of 3 minutes, to allow the moisture sensor to stabilise and give an accurate reading. ("Measure Water Content" box in the Remote Device Settings window has to be ticked to obtain a result).

Temperature is displayed in °C and moisture is expressed in % RH (Relative Humidity).

8 Continuous Sampling

The CML2 can be selected for continuous testing at set time intervals.

Once continuous sampling has started the CML2's flush valve automatically opens and closes before each test. This allows representative fluid to reach the sensing arrangement before the 15ml sampling test commences. The flush valve automatically opens at the end of the sampling cycle and remains open whilst the CML2 is emptying to waste the sample fluid from the previous test.[4] Additionally, depending on the time set for Minutes Between Tests, the Flush valve operates as follows:-

Time set to 0 – At the end of the CML2's emptying cycle the flush valve automatically closes and the next sampling test immediately starts.

Time set to between 1 and 5 – After the CML2's emptying cycle has finished the flush valve remains open for the time set, then automatically closes before the next sampling test.

Time set to between 6 and 30000 – Flush valve automatically closes after the emptying cycle has finished and remains closed until 5 minutes before the next sample test is programmed to start.

[4] The servo motor operating the Flush valve may exhibit a slight 'ticking' noise, both when it is open and closed. This is normal.

8.1 Continuous Test Basic Operation

1. Follow the instructions on page 25 for inputting settings - select Continuous Test Type.

2. Input Test Interval - input the time in minutes that is required between the end of a test and the begining of a new test.

3. Input:

   - 0 (zero) ISO Cleanliness Target
   - 0 (zero) NAS1638/AS4059E-1 Cleanliness Target
   - 0 (zero) AS4059E-2 Cleanliness target (displayed as: *A / *B / *C / *D / *E / *F after pressing OK)
   - 0 (zero) ISO Dirty Alarm Target
   - 0 (zero) NAS1638/AS4059E-1 Dirty Alarm Target
   - 0 (zero) AS4059E-2 Dirty Alarm Target (displayed as: *A / *B / *C / *D / *E / *F after pressing OK)

4. Insert a tick in the "Log all test results" box. This will log every test that is carried out in the continuous test mode, into the memory of the CML2. If the box is not ticked none of the test results will be stored in the memory of the CML2.

5. Press OK button to save settings and return to Remote Device dialogue.

6. Press Flush button to open flush valve - flush indicator turns yellow to indicate valve is open. Leave valve open until at least 200ml has passed to waste.

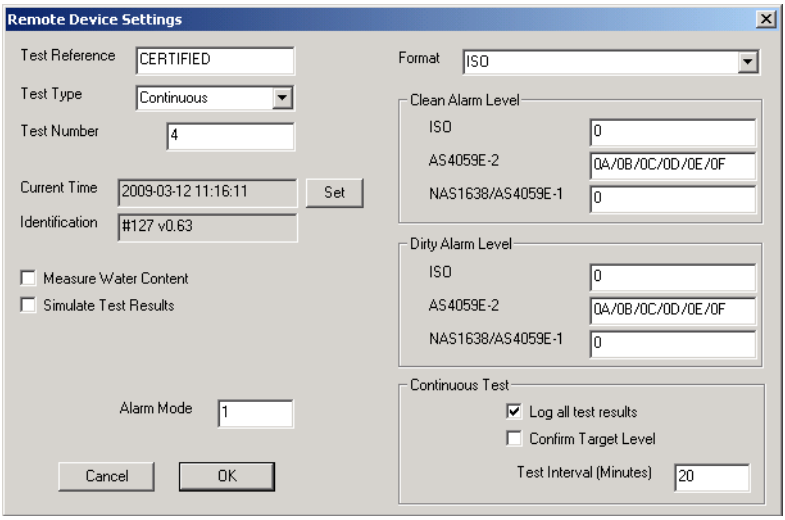


Figure 1 Continuous Test Settings

7. Press Stop button to close flush valve.

8. Press Start button. The CML2 will now commence the sampling cycle.

9. The completion progress bar indicates the status of the test. Results will be automatically displayed on the Remote Device dialogue after each test.

10. The status is shown as Waiting between the ending of one test and the starting of the next test.

11. Press the Stop button at any time in the cycle to end the continuous sampling. The test status will show as Idle.

8.1.1 Continuous Sampling – with Clean Alarm Levels – Alarm Mode 1

This operating mode is similar to the Basic Operation, but in this mode the CML2 will stop testing when the specified clean alarm level is achieved.

A status of "C" is shown on the LCD when the specified clean alarm level is achieved meaning completed.

- Follow the instructions on page 25 for inputting settings - select Continuous Test Type.
- Alarm mode should be set to the default of 1.
- Input Test Interval – input the time in minutes that is required between the end of a test and the begining of a new test.
- Cleanliness Target options:

  Clean Alarm Level (ISO) - Input desired Clean Alarm Level in the code format Number/ Number/ Number – any code number combination can be input, from code 5 to 24, example 10/9/5.

  For continuous testing until the ISO Code is achieved, select ISO Format in the Remote Device Settings dialogue, as described under the previous section on page 25.

  Testing will automatically continue until each of the three numbers in the Code have been achieved (or cleaner).

  Clean Alarm Level (NAS1638/ AS4059E-1) - Input desired Clean Alarm Level, as a single Class number in the range 2 to 12 inclusive.

  For continuous testing until the (NAS1638/ AS4059E-1) Class is achieved, select NAS Format or AS4059E Table 1, as described

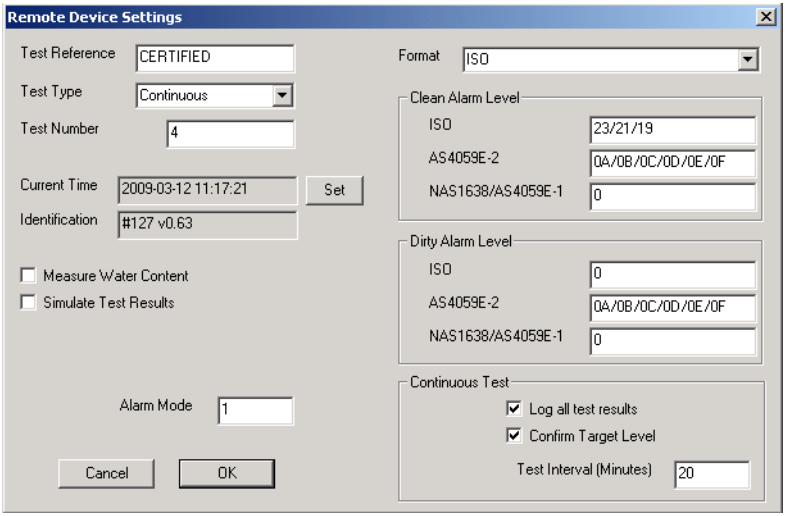


Figure 2 Setting ISO Target Cleanliness Level

on page 25. Testing will automatically continue until the Class number has been achieved at each of the five size ranges covered by NAS1638 & AS4059E Table 1. Note: AS4059E-1 denotes Table 1 of the AS4059E standard.

Clean Alarm Level (AS4059E-2) - Input desired Clean Alarm Level in the format 1A/2B/3C/4D/5E/6F in the following range:

Size Code A: 000 to 12
Size Code B: 00 to 12
Size Code C: 00 to 12
Size Code D: 2 to 12
Size Code E: 4 to 12
Size Code F: 7 to 12

Example, 4A/4B/5C/6D/6E/7F.

For continuous testing until the AS4059E Table 2 size codes are achieved, select AS4059E TABLE 2 FORMAT, as described on

page 25. Testing will automatically continue until the Class number has been achieved at each of the six Size Codes.

Also, the CML2 will handle deviations from the above format intelligently. The size code can be out of order: 7F / 4A / 5C / 4B / 6E / 6D

If any sizes are missing, they will be assigned the “*” value. The effect of this is a “don’t care” value when used as the cleanliness target. For example, 6B/6C/7D is translated as *A/6B/6C/7D/*E/*F. In this case, testing will continue until the B, C and D Classes are less than or equal to 6, 6, 7 respectively. The A, E and F Classes are effectively ignored since they cannot ever be “ worse” than a “*” Class. Note: AS4059E-2 denotes Table 2 of the AS4059E standard.

- "Log all test results" box - A tick in this box will log every test that is carried out in the continuous test mode, into the memory of the CML2. If the box is not ticked then the CML2 will only store the results of the test when the Target Cleanliness Level is achieved - this saves on memory space.

  The CML2 has a memory capacity of approximately 600 tests. When this memory is full, the earliest of the test records will be over-written by the newest tests.

- Inserting a tick in the "Confirm Target Level" box instructs the CML2 to repeat the sampling cycle until the target cleanliness level has been achieved in two consecutive samples, before the Complete status is displayed.

  Leaving the "Confirm Target Level" box blank permits the target cleanliness level to be achieved only one time before the Complete status is displayed.

- Press OK button to save settings and return to Remote Device dialogue.
- Press Flush button to open flush valve - flush indicator turns yellow to indicate valve is open. Leave valve open until at least 200ml has passed to waste.
- Press Stop button to close flush valve.
- Press Start button, the CML2 will now commence the sampling cycle.
- The Completion progress bar indicates the status of the test. Results will be automatically displayed on the Remote Device dialogue after each test.
- The status is shown as Waiting between the ending of one test and the starting of the next test.
- Press the Stop button at any time in the cycle to end the continuous sampling. The test status will show as Idle.

8.2 With Moisture Sensor

Continuous Test - Basic Operation and *Continuous Test - with Target Cleanliness Level*

The procedure is similar to that detailed for the CML2 without moisture sensor (previous section), except when the Start button is pressed the flush valve will open automatically for a period of at least 3 minutes before the test commences; this is to allow the moisture sensor to stabilise and give an accurate reading. ("Measure Water Content" box in the Remote Device Setting dialogue has to be ticked to obtain a result).

For example, if zero minutes is input in the "Test Interval" box, the effective time between one test finishing and the next starting will be 3 minutes. Temperature is displayed in °C and moisture is expressed in % RH (Relative Humidity).

9 Moisture Sensor

The CML2 version fitted with the optional moisture sensor module allows both measurement of % saturation of water in oil (Relative Humidity) and temperature. These are displayed as RH % and °C on the main/test progress screen and on the downloaded results.

Temperature measurement provides a reference temperature for the RH reading.

> Due to the temperature gradient existing between the system tapping point and the RH/temperature module, the temperature reading can be 5°C to 10°C less than the actual system temperature, depending on operating conditions.

The CML2 can be configured to do a test with or without the moisture sensor selected. If the moisture sensor has been selected, the flush valve will open automatically for a period of 3 minutes before the particle count test commences. This is to allow the moisture sensor to stabilise and give an accurate reading.

To switch the moisture sensor on, select the Settings option in the Remote Device dialogue, as described on page 25. The "Measure Water Content" box should be ticked.

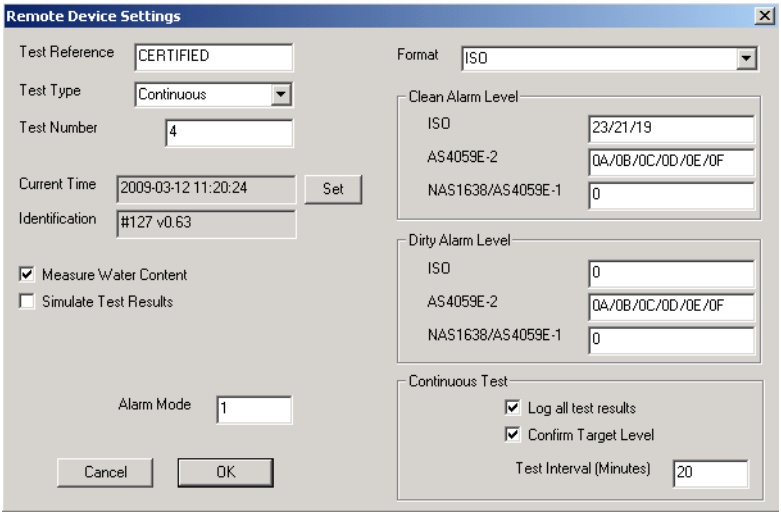


Figure 1 Measure Water Content Enabled

10 Bottle Sampling

An alternative to operating on-line is to use MP Filtri UK's Bottle Sampling Unit to test oil contained in bottles. Refer to the separate User Guide for details.

11 Battery Charging (series 41 only)

The CML2 is equipped with an internal rechargeable battery capable of sustaining 50 continuous tests following a 24 hour charging period.

When the low battery level LED is illuminated the CML2 requires recharging as soon as possible.

> Before commencing recharging always turn off the CML2.

To recharge, connect lead from power adaptor to the DC power input socket on the CML2. Observe that the battery charge indicator illuminates on the CML2.

Battery power may be conserved by:

- Operating CML2 whilst connected to power adaptor.
- Switching CML2 off between samples.

Should the battery become completely discharged it is advisable to allow a minimum of 15 minutes charge time prior to commencing a test. The CML2 must remain connected to the power adaptor during subsequent tests until the battery has had time to recharge.

Total discharge will shorten the battery lifetime so should be avoided where possible.

12 Warranty

The CML2 is guaranteed for 12 months upon receipt of the CML2, subject to it being used for the purpose intended and operated in accordance with this User Guide.

12.1 Recalibration

MP Filtri UK will only verify the accuracy of the CML2 if the unit is recalibrated every 12 months.

> Please ensure that the test results in the Log are downloaded to LPA-View before the CML2 is despatched, in case action taken by MP Filtri UK during the service / recalibration causes the Log to be cleared.

It is requested that only the CML2, not the support case or any other ancilliaries, be returned for recalibration.

MP Filtri UK will not be held responsible for any items returned as such.

Ensure that the CML2 is packed appropriately for transportation.

Measuring Water in Hydraulic and Lubricating Fluids

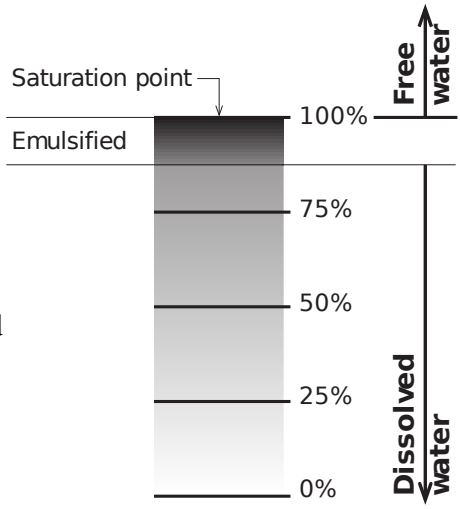
From North Notts Fluid Power Centre

In mineral oils and non aqueous fire resistant fluids water is undesirable. Mineral oil usually has a water content of 50-300 ppm which it can support without adverse consequences.

Once the water content exceeds about 500ppm the oil starts to appear hazy. Above this level there is a danger of free water accumulating in the system in areas of low flow. This can lead to corrosion and accelerated wear. Similarly, fire resistant fluids have a natural water content which may be different to mineral oils.

Saturation Levels

Since the effects of free (also emulsified) water is more harmful than those of dissolved water, water levels should remain well below the saturation point. However, even water in solution can cause damage and therefore every reasonable effort should be made to keep saturation levels as low as possible. There is no such thing as too little water. As a guideline, we recommend maintaining saturation levels below 50% in all equipment.



Typical Water Saturation Levels For New Oils

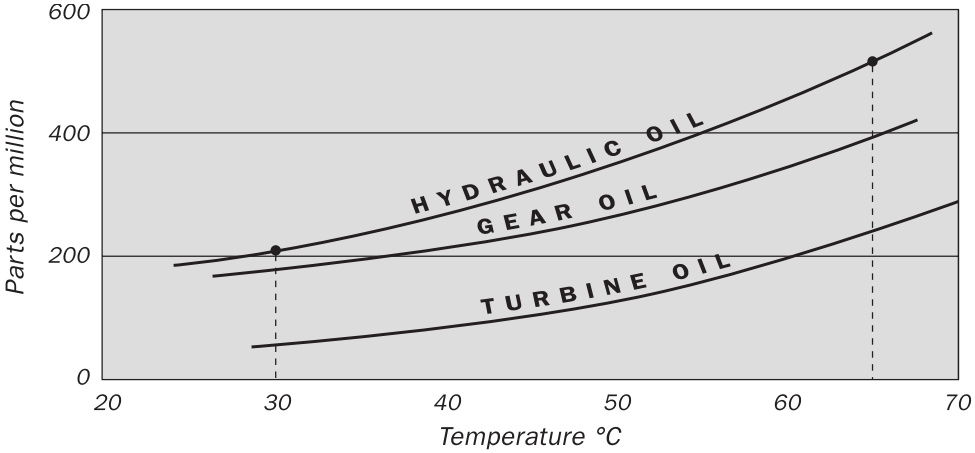


Figure I

Examples: Hydraulic oil @ 30°C = 200ppm = 100% saturation
Hydraulic oil @ 65°C = 500ppm = 100% saturation

ISO4406:1999 Cleanliness Code System

The International Standards Organization standard ISO 4406:1999 is the preferred method of quoting the number of solid contaminant particles in a sample.

The code is constructed from the combination of three scale numbers selected from the following table.

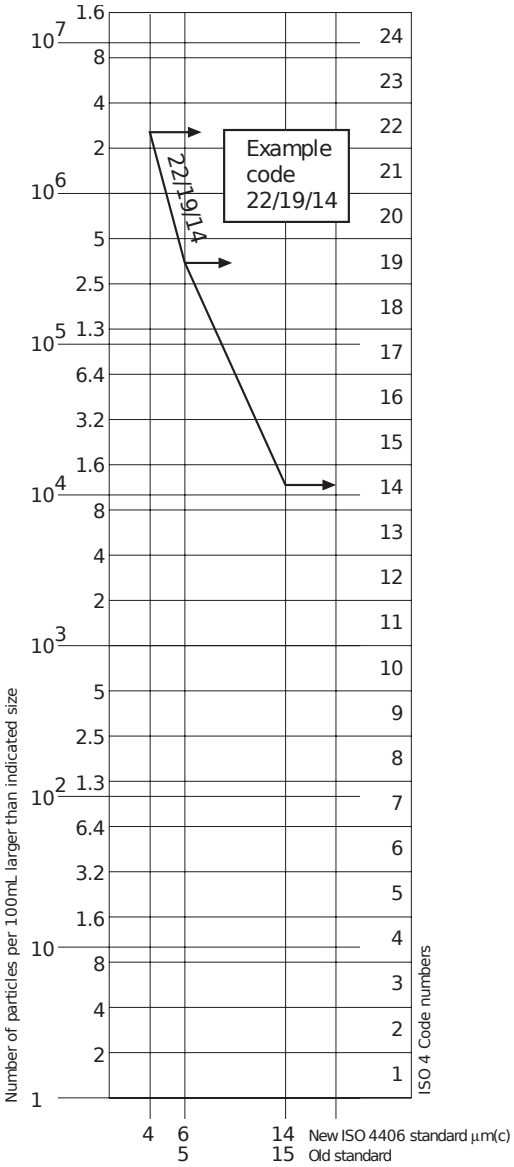
The *first* scale number represents the number of particles in a millilitre sample of the fluid that are larger than 4 µm(c).

The *second* number represents the number of particles larger than 6 µm(c).

The *third* represents the number of particles that are larger than 14 µm(c).

Number of Particles per mL		*Scale No.*
More than	*Up to and including*	
2.5M	-	> 28
1.3M	2.5M	28
640k	1.3M	27
320k	640k	26
160k	320k	25
80k	160k	24
40k	80k	23
20k	40k	22
10k	20k	21
5000	10k	20
2500	5000	19
1300	2500	18
640	1300	17
320	640	16
160	320	15
80	160	14
40	80	13
20	40	12
10	20	11
5	10	10
2.5	5.0	9
1.3	2.5	8
0.64	1.3	7
0.32	0.64	6
0.16	0.32	5
0.08	0.16	4
0.04	0.08	3
0.02	0.04	2
0.01	0.02	1
0.0	0.01	0

Microscope counting examines the particles differently to APCs and the code is given with two scale numbers only. These are at 5 µm and 15 µm equivalent to the 6 µm(c) and 14 µm(c) of the APCs.



NAS1638 Cleanliness Code System

The NAS system was originally developed in 1964 to define contamination classes for the contamination contained within aircraft components. The application of this standard was extended to industrial hydraulic systems simply because nothing else existed at the time. The coding system defines the maximum numbers permitted of 100ml volume at various size intervals (differential counts) rather than using cumulative counts as in ISO 4406:1999. Although there is no guidance given in the standard on how to quote the levels, most industrial users quote a single code which is the highest recorded in all sizes and this convention is used on the CML2 software.

	00	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
5-15	125	250	500	1000	2000	4000	8000	16000	32000	64000	128000	256000	512000	1024000
15-25	22	44	89	178	356	712	1425	2850	5700	11400	22800	45600	91200	182400
25-50	4	8	16	32	63	126	253	506	1012	2025	4050	8100	16200	32400
50-100	1	2	3	6	11	22	45	90	180	360	720	1440	2880	5760
Over 100	0	0	1	1	2	4	8	16	32	64	128	256	512	1024

Figure I CONTAMINATION LEVEL CLASSES according to NAS1638 (January 1964).

The contamination classes are defined by a number (from 00 to 12) which indicates the maximum number of particles per 100 ml, counted on a differential basis, in a given size bracket.

SAE AS4059 REV.E Cleanliness Classification For Hydraulic Fluids[V]

This SAE Aerospace Standard (AS) defines cleanliness levels for particulate contamination of hydraulic fluids and includes methods of reporting data relating to the contamination levels. Tables 1 and 2 below provide the Maximum Contamination Limits (Particles/100ml) of differential and cumulative particle counts respectively for counts obtained by an automatic particle counter, e.g. CML2.

[V] The information reproduced on this and the previous page is a brief extract from SAE AS4059 Rev.E, revised in May 2005. For further details and explanations refer to the full Standard.

Size range μm(c):	6 - 14	14 - 21	21 - 38	38 - 70	>70
Class					
00	125	22	4	1	0
0	250	44	8	2	0
1	500	89	16	3	1
2	1,000	178	32	6	1
3	2,000	356	63	11	2
4	4,000	712	126	22	4
5	8,000	1,425	253	45	8
6	16,000	2,850	506	90	16
7	32,000	5.700	1,012	180	32
8	64,000	11,400	2,025	360	64
9	128,000	22,800	4,050	720	128
10	256,000	45,600	8,100	1,440	256
11	512,000	91,200	16,200	2,880	512
12	1,024,000	182,400	32,400	5,760	1,024

Table I AS4059E Table 1 - Cleanliness Classes for Differential Particle Counts

Size μm(c)	>4	>6	>14	>21	>38	>70
Size Code	A	B	C	D	E	F
Classes						
000	195	76	14	3	1	0
00	390	152	27	5	1	0
0	780	304	54	10	2	0
1	1,560	609	109	20	4	1
2	3,120	1,217	217	39	7	1
3	6,250	2,432	432	76	13	2
4	12,500	4,864	864	152	26	4
5	25,000	9,731	1,731	306	53	8
6	50,000	19,462	3,462	612	106	16
7	100,000	38,924	6,924	1,224	212	32
8	200,000	77,849	13,849	2,449	424	64
9	400,000	155,698	27,698	4,898	848	128
10	800,000	311,396	55,396	9,796	1,696	256
11	1,600,000	622,792	110,792	19,592	3,392	512
12	3,200,000	1,245,584	221,584	39,184	6,784	1,024

Table II AS4059E Table 2 - Cleanliness Classes for Cumulative Particle Counts

Recommendations

Unit	*Type*	*ISO 4406:1999 Code*
PUMP	Piston (slow speed, in-line)	22/20/16
	Piston (high speed, variable)	17/15/13
	Gear	19/17/15
	Vane	18/16/14
MOTOR	Axial piston	18/16/13
	Radial piston	19/17/13
	Gear	20/18/15
	Vane	19/17/14
VALVE	Directional (solenoid)	20/18/15
	Pressure control (modulating)	19/17/14
	Flow control	19/17/14
	Check valve	20/18/15
	Cartridge valve	20/18/15
	Proportional	18/16/13
	Servo-valve	16/14/11
ACTUATOR		20/18/15

Table I Typical Manufacturers Recommendations for Component Cleanliness (ISO 4406:1999)[VI]

Most component manufacturers know the proportionate effect that increased dirt level has on the performance of their components and issue maximum permissible contamination levels. They state that operating components on

[VI] It should be noted that the recommendations made in this table should be viewed as starting levels and may have to be modified in light of operational experiences or user requirements.

fluids which are cleaner than those stated will increase life. However, the diversity of hydraulic systems in terms of pressure, duty cycles, environments, lubrication required, contaminant types, etc, makes it almost impossible to predict the components service life over and above that which can be reasonably expected. Furthermore, without the benefits of significant research material and the existence of standard contaminant sensitivity tests, manufacturers who publish recommendations that are cleaner than competitors may be viewed as having a more sensitive product.

Hence there may be a possible source of conflicting information when comparing cleanliness levels recommended from different sources.

The table gives a selection of maximum contamination levels that are typically issued by component manufacturers. These relate to the use of the correct viscosity mineral fluid. An even cleaner level may be needed if the operation is severe, such as high frequency fluctuations in loading, high temperature or high failure risk.

Hydraulic System Target Cleanliness Levels

Where a hydraulic system user has been able to check cleanliness levels over a considerable period, the acceptability, or otherwise, of those levels can be verified. Thus if no failures have occurred, the average level measured may well be one which could be made a bench mark. However, such a level may have to be modified if the conditions change, or if specific contaminant-sensitive components are added to the system. The demand for greater reliability may also necessitate an improved cleanliness level.

The level of acceptability depends on three features:

- the contamination sensitivity of the components
- the operational conditions of the system
- the required reliability and life expectancy

Contamination Codes ISO 4406:1999			Corresponding Codes NAS 1638	Recommended Filtration Degree	Typical Applications
4 µm(c)	6 µm(c)	14 µm(c)		Bx200	
14	12	9	3	3	High precision and laboratory servo-systems
17	15	11	6	3-6	Robotic and servo-systems
18	16	13	7	10-12	Very sensitive - high reliability systems
20	18	14	9	12-15	Sensitive - reliable systems
21	19	16	10	15-25	General equipment of limited reliability
23	21	18	12	25-40	Low - pressure equipment not in continuous service

The table above is a guide to the recommended filtration level for various hydraulic components, together with typical target system cleanliness levels.

New ISO Medium Test Dust and its effect on ISO Contamination Control Standards

When General Motors gave advance warning to the International Standards Organization (ISO) that it was intending to stop the production of AC Fine Test Dust (ACFTD), work commenced immediately on finding an improved replacement dust. ACFTD was used extensively within the fluid power and automotive industries for calibrating Automatic Particle Counters (APCs) and for the testing of components.

APCs are used for testing oil filters, and also for contaminant sensitivity testing of hydraulic components. For 25 years, APCs have been the main stay in the measurement of solid particles in hydraulic fluids. The growth in demand for measuring fluid cleanliness in a variety of industrial processes, including fluid power, has resulted in APCs moving from the laboratory environment out into the factory. In fact, they are now a critical part of many production processes. It is therefore essential that the data they provide is both accurate and consistent.

Calibration

ACFTD has been used as an artificial contaminant since the 1960s and its original particle size distribution was determined using an optical microscope. This particle size distribution subsequently formed the basis of ISO 4402, the method for calibrating APCs. Due to the limitations of that method of measurement, the particle size distribution was questioned below about 5µm. It was also not traceable to any national standard of measurement - a critical requirement for today's quality management systems.

There was also an absence of formal controls over the distribution of the test dust, and batch-to-batch variability was much greater than is acceptable nowadays.

ISO therefore defined the requirements for the replacement for ACFTD and asked the National Institute of Standards and Technology (NIST) in the USA to produce a standard, traceable reference material. The new dust's particle size distribution has been accurately determined with the aid of modern scanning electron microscope and image analysis techniques.

New Test Dust Benefits

The new ISO Medium Test Dust (ISO MTD) consists of similar materials to the old ACFTD, but to minimize particle counting errors, it is of a slightly coarser grade because ACFTD included too many particles smaller than 5µm which gave problems during testing.

ISO MTD is produced to a standard distribution and stringent quality control procedures, thereby ensuring excellent batch-to-batch repeatability. These procedures, combined with a revised ISO APC calibration method give:

- A traceable and controlled reference test dust with greatly reduced variation in particle size distribution. This gives the trace-ability required by ISO 9000, QS9000 and similar quality management systems.
- A procedure for determining the performance of APCs so that minimum acceptable levels can be set by the user.
- Improved calibration techniques and procedures.
- More accurate calibration.
- Improved levels of particle count reproducibility with different equipment.
- More accurate and consistent filter test results.

Effect on Industry

The introduction of ISO MTD has necessitated changes to certain ISO standards.

The standards affected include:

ISO 4402:1991 Hydraulic fluid power
Calibration of liquid automatic particle counters.

ISO 4406:1987 Hydraulic fluid power
Code for defining the level of contamination by solid particles.

ISO 4572:1981 Hydraulic fluid power – Filters
Multi-pass method for evaluating filtration performance of a filter element.

In order that users are not confused by the changes to these standards, particularly by reference to them in technical literature, ISO is updating 4402 to ISO 11171, and 4572 to ISO 16889.

Two standards which concern our industry are the ISO 4406 coding system and the new ISO 16889 Multi-pass test. As APCs will henceforth count particles more accurately, there will now be a change in the way sizes are labelled.

In the new ISO 4406:1999, new calibration sizes are used to give the same cleanliness codes as the 'old' calibration sizes of 5 and 15 µm. In this way, there will be no necessity to change any system cleanliness specifications. It is proposed that the cleanliness codes (for APCs) will be formed from three[VII] particle counts at 4, 6 and 14 µm, with 6 and 14 µm corresponding very closely to the previous 5 and 15 µm measurements. This will ensure consistency in data reporting.

As the counts derived by microscope counting methods are not affected, the particle sizes used for microscopy will remain unchanged (i.e. at 5 and 15 µm).

[VII] The option of quoting just two counts of 6µm and 14µm for APCs remains.

To clarify matters still further, ISO standards written around the new test dust will utilize a new identifier, '(c)'. Hence µm sizes according to the new ISO 11171 will be expresses as 'µm(c)' and Beta ratios according to ISO 16889 will be expressed as 'Bx(c)', e.g.'B5(c)'.

However, it must be stressed that the only real effect users will experience will be the improved accuracy in particle counts - there will be no change in the performance of filters, nor in the ISO cleanliness levels that they will achieve.

The following charts shows the correlation between the old ACFTD and the new ISO MTD.

The CML2 is calibrated with ISO Medium Test Dust (to ISO 11171). The correlation between particle sizes and the ACFTD (old standard) to the ISO MTD (new standard) is as follows :

ACFTD	<1	5	15	25	30	50	75	100
ISO MTD	4	6	14	21	25	38	50[VIII]	70[IX]

[VIII] Not verified by NIST
[IX] acftd

Correlation

The table shows the correlation between Particle Sizes Obtained using ACFTD (ISO 4402:1991) and NIST (ISO 11171) Calibration Methods

This table is only a guideline. The exact relationship between ACFTD sizes and the NIST sizes may vary from instrument to instrument depending on the characteristics of the particle counter and original ACFTD calibration.

Particle Size Obtained Using ACFTD (ISO 4402:1991) µm	ISO/NIST MTD (ISO 11171) µm(c)
1	4.2
2	4.6
3	5.1
4	5.8
5	6.4
6	7.1
7	7.7
8	8.4
9	9.1
10	9.8
11	10.6
12	11.3
13	12.1
14	12.9
15	13.6
16	14.4
17	15.2
18	15.9
19	16.7
20	17.5
21	18.2
22	19.0
23	19.7
24	20.5
25	21.2
26	22.0
27	22.7
28	23.5
29	24.2
30	24.9
31	25.7
32	26.4
33	27.1
34	27.9
35	28.5
36	29.2
37	29.9
38	30.5
39	31.1
40	31.7

Appendix G

Other Standards

Although the ISO 4406:1999 standard is being used extensively within the hydraulics industry other standards are occasionally required and a comparison may be requested. The following table gives a very general comparison but often no direct comparison is possible due to the different classes and sizes involved.

[x] All section headings indicated with [] are reproduced by kind permission of British Fluid Power Association from BFPA/P5 1999 issue 3 Appendix 44

ISO 4406:1999	DEF.STD 05/42 [7][X]		NAS 1638[5]	SAE 749[8]
	Table A	Table B	ISO 11218[6]	
13/11/08			2	
14/12/09			3	0
15/13/10			4	1
16/14/09		400F		
16/14/11			5	2
17/15/09	400			
17/15/10		800F		
17/15/12			6	3
18/16/10	800			
18/16/11		1,300F		
18/16/13			7	4
19/17/11	1,300	2000F		
19/17/14			8	5
20/18/12	2,000			
20/18/13		4,400F		
20/18/15			9	6
21/19/13	4,400	6,300F		
21/19/16			10	
22/20/13	6,300			
22/20/17			11	
23/12/14	15,000			
23/21/18			12	
24/22/15	21,000			
25/23/17	100,000			

Table I

Clean working practises

The majority of hydraulic systems require cleanliness which controls below around a 40 micron threshold (beyond the limit of human eyesight). When analysing particles down to levels of 4um, 6um & 14um you are talking about objects of a cellular/bacterial size. This creates various challenges, and is starting to drive better and cleaner working practices in industry. Our products are at the forefront of this challenge, and will help you to manage the quality and productivity of your systems.

Do's

- Do use filter breathers on tank tops.
- Do use tank designs, which are self draining (sloped or conical).
- Do use tanks which can be sealed off from the surrounding environment.
- Do exercise care and use funnels when filling tanks with fluid.
- Do utilize stainless steel and methods such as electro-polishing in the design of system components upstream of your first filter set.
- Do perform off-line analysis in a controlled environment such as a laboratory which should contain fewer airborne contaminants that where the sample was taken from.
- Do use suitable, glass bottles (ideally certified clean) to take samples, along with a hand pump to reduce contamination ingress.
- Do filter your system thoroughly before using it in your production process.

- Do perform a statistically large enough sample of particle analysis results (25) to arrive at a base cleanliness level for your system.
- Do make sure that filters are correctly sized for your applications and cleanliness you are trying to achieve.

Don'ts

- Don't eat, drink or smoke around critical systems/processes.
- Don't leave tools, objects, clothing or other materials etc. on surfaces or tanks of critical systems.
- Don't use open tanks on critical systems.
- Don't take samples or perform on-line analysis from the top of a reservoir/tank.
- Don't design/use tanks which contain crevices (internal corners etc).
- Don't assume that if a sample looks clean, that it is. You wont be able to see the contaminants.
- Don't perform off-line analysis in an "un-controlled" environment. E.g. workshop.
- Don't rely on a single test for a capable representation of your system.
- Don't start using your system/process until it has gone through a commissioning period whereby contamination levels are relatively stable.
- Don't mix fluids into the same system. They can emulsify and eliminate any chance of a reliable particle count.
- Don't use unsuitable containers to take a fluid sample.

Specification

As a policy of continual improvement, MP Filtri UK reserve the right to alter the specification without prior notice.

Optical Package	Twin Laser and Twin Optical Diode Detectors
Sensitivity	>4,6,14,21,25,38,50,70 µm(c) sizes to revised ISO 4406: 1999 Standard
Accuracy / repeatability	Better than 3% typical
Calibration	Each unit is individually calibrated with ISO Medium Test Dust (MTD) based on ISO 11171: 1999 on equipment certified by I.F.T.S.
Analysis Range	ISO 8 to ISO 24 to ISO 4406: 1999 NAS 1638: 2 to 12 AS4059E Table 1: 2 to 12 AS4059E Table 2: Size Codes A: 000 to 12, B: 00 to 12, C: 00 to 12, D: 2 to 12, E: 4 to 12, F: 7 to 12
CML2 Sample volume	15 ml. (normal) 30 ml. (dynamic) 24 ml. (bottle sampler) 15 ml. (continuous) 8ml. (short)
Operation	Max. system working pressure: 400 bar. Min. working pressure: 2 bar
Viscosity range	to 400 centistokes
Operating temperature	+5 to +80°C

Electrical Requirement	12 to 24V DC 1 amp max, (15V supplied with series 35, 40) (12V supplied with series 41)
Battery Life (Series 41 only)	Internal battery pack performs approx. 60 tests prior to recharge requirement.
Moisture & Temp Meas.	Included on CML2-W model
Fluid compatibility	Mineral oil & petroleum based fluids (consult MP Filtri UK for other fluids)
Typical test time	Result in <2.5 mins. (normal test)
Data storage	600 tests
Computer interface	RS 232 communication port
Hose connections	Minimess fittings Microbore hose 1.5 metres long Waste fluid hose
Dimensions	Height 152mm Length 340mm Width 295mm Weight 5.9 kilos

CML2 Upper Contamination Limit

The CML2 upper operating limit is set at 24/22/20. Tests that result in particle counts exceeding any scale number in the three part ISO upper limit has the scale number replaced by asterisk on the remote Display (optional equipment), example */*/*. Similarly for NAS1638/AS4059E-1 and AS4059E-2 the Display will show ** and * respectively.

Within LPA-View, exceeding the upper contamination level is denoted by the use of code 25 in the case of ISO, and Class 15 for NAS1638/AS4059E-1 and AS4059E-2.

Spare Product / Part Numbers

For spares and part numbers please see the website:

www.mpfiltri.co.uk

Fault Finding

FAULT	CHECK
Unexpected results obtained from sample	Check that the test hose has been fully connected at both the system and the CML2 ends. Confirm that there is a free flow of fluid to the CML2, by operating the flush valve and observing fluid passing to waste. High water/ aeration levels.
Remote Device dialogue not responding to buttons being pressed	Check that correct COM port has been selected in the Remote Device dialogue. Disconnect power supply to CML2 and then reconnect it.

If excessive system contamination is suspected, flush out the CML2 using a Bottle Sampling Unit in conjunction with a suitable solvent. Please see website for flushing fluid information: www.mpfiltri.co.uk

DO NOT USE ACETONE

Produced by MP Filtri UK

Revision 4.1

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